IPGRI

Annual Report 1999

International Plant Genetic Resources Institute

Contents of the 1999 Annual Report

IPGRI's strategic choices

Improving conservation strategies and technologies
Understanding the extent and distribution of diversity; supporting collecting of genetic resources; improving *ex situ* and *in situ* conservation and developing integrated approaches

Increasing the use of plant genetic resources
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Working with networks
Supporting established regional, crop and thematic networks and helping to develop new ones to strengthen international collaboration

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Annual Report 1999

Foreword to IPGRI's 1999 Annual Report

IPGRI celebrated its 25th anniversary in 1999, at the brink of the new millennium. This event prompted us to take stock of what we have accomplished and where we are going as an institute. In the process, we took a long hard look at the institutional strategy, *Diversity for Development*, and addressed the need for some revision. Our new strategy, published this year, reflects the tremendous progress that has been made in the field of genetic resources since the publication of the first strategic plan in 1994.

It is difficult to believe that only five years ago the Convention on Biological Diversity was in its infancy, the Leipzig Conference on plant genetic resources was still two years in the future, and the renegotiation of the International Undertaking had only just begun. Today, the issue of agricultural biodiversity is firmly fixed on the international policy agenda. At the same time, major advances have occurred in the fields of conservation science and technology, biotechnology and information management. Unfortunately, the loss of plant biodiversity has kept pace with these advances, the result of growing population pressures, industrial development and other changes in land use. Unfortunately too, the world has yet to reach agreement on a revised International Undertaking governing access to plant genetic resources and the sharing of benefits arising from their use.

IPGRI's original strategy was based on the recognition that collecting and conserving genetic resources was essential to any agricultural development effort. Over the years, IPGRI has sponsored nearly 600 collecting missions in developing countries, gathering around a quarter of a million plant species for conservation in national and international genebanks. While conservation remains a key goal, the Institute's new strategy stresses the importance of *using* diversity for development. This includes the use of diversity to support genetic enhancement, in some cases, the task of genetic enhancement itself, and the deployment of traditional or enhanced germplasm to enrich production systems.

For its part, IPGRI is barely recognizable as the institute that got its start in 1974 as the International Board for Plant Genetic Resources (IBPGR). Genetic resources science was a relatively new discipline at that time and IBPGR's founders could not have imagined how much the needs of national programmes would change over the years, nor how greatly the institute's range of activities would expand to better serve those needs.

In the early days, most of IBPGR's resources were directed towards collecting and support for *ex situ* conservation. Twenty-five years later, we have major activities devoted to *in situ* conservation, forest genetic resources, capacity building, socio-economics, law and policy, managing and communicating information, and supporting improved germplasm management strategies and technologies. Two of IPGRI's three programmes (the third being the Plant Genetic Resources Programme), the CGIAR Support Programme and the International Network for the Improvement of Banana and Plantain (INIBAP) have been added to the institutional roster in the past five years.

IPGRI's expansion over the years mirrors the growth in global knowledge and recognition of the value of genetic resources for use in human development. We believe that IPGRI can take some credit for that growth and for increasing the awareness of national policy-makers of the importance of the conservation and use of agricultural biodiversity. Our *modus*

Mexican farmer participants in IPGRI's *in situ* project standing among crops in their home garden

Devra Jarvis, IPGRI

operandi, and in particular the emphasis on working through partnerships, has enabled us to make a strong, flexible response to the needs and constraints of genetic resources programmes around the world.

The late Abdou-Salam Ouédraogo, IPGRI's Regional Director for Sub-Saharan Africa, played a major role in helping us to realize this accomplishment. Abdou was tragically killed in the Kenya Airways crash in the early days of the new millennium. We grieve for his loss as an institute and as friends, knowing that no one will ever be able to take his place. But we are grateful that, for a little while, we had the privilege and honour to work with Abdou and to be inspired by his enormous humour, his boundless faith and his determination to put plant and forest genetic resources to work for development. This report is dedicated to his memory and to that of Professor James Chweya, IPGRI Honorary Research Fellow, who sadly also passed away during 1999.

This annual report provides a snapshot of some key projects and activities in 1999. It provides evidence that, given continued strong support from our donors, IPGRI can continue to play a significant role in supporting global efforts to conserve and use plant genetic resources.

Geoffrey Hawtin
Director General

Marcio de Miranda Santos
Board Chair

W. Gartung, FAO

IPGRI

Introduction

For the past 25 years, IPGRI has helped to guide efforts around the world to conserve and use plant genetic resources. The institute has made an important impact at both national and international levels in spite of its relatively small size and modest budget. In large part this impact is due to IPGRI's particular way of working, its *modus operandi*. Rather than building, operating and maintaining its own research facilities, IPGRI dedicates most of its resources to:

- creating knowledge about genetic resources
- building skills within the research and conservation communities
- enhancing institutional capacity to support genetic resources research and management
- informing and promoting supportive policies for genetic resources research and management.

IPGRI's approach has been successful because it builds capacity among countries to conduct their own research and to make informed choices about how to conserve and use their genetic resources. Collaboration and partnership are increasingly valued by public institutions, businesses and development organizations faced with complex decisions, rapidly changing environments and declining resources. A collaborative approach, as reflected in IPGRI's *modus operandi*, leads to better outcomes at lower cost, multi-stakeholder ownership of the process and outcomes, and comprehensive solutions to intricate problems.

Giovanni Delogu

Opposite page, left, food station in eastern Chad; right, preparing maize flour in western Africa; this page, barley fields at the Istituto Sperimentale per la Cerealicoltura, Fiorenzuola d'Arda, Italy

The four dimensions of IPGRI's *modus operandi* are:

1. **Creating and sharing knowledge by:**
   - Collaborative research partnerships that tackle high priority issues
   - Developing methods and tools with wide and durable applicability.

2. **Building skills and knowledge in specific technical areas by:**
   - Sponsoring education, training and workshops
   - Supervising Master's and PhD students
   - Developing and promoting self-study training programmes
   - Providing current information.

3. **Enhancing institutional capacity to support genetic resources research and sustainable management by**:
   - Developing management skills
   - Developing training skills, curricula and educational materials
   - Building research infrastructure
   - Promoting collaboration through networks.

4. **Promoting the establishment of a supportive policy environment by:**
   - Helping to develop supportive national legislation
   - Helping governments participate effectively in international fora
   - Promoting international dialogue and supporting international agreements.

National programmes are the means by which a country conserves and manages its genetic resources. Equally important, national programmes provide the foundation for international and regional collaboration and dialogue. No country can rely exclusively on its own genetic resources to maintain its agriculture and forestry sectors. The reliance of countries on introduced crops clearly points to the need for the international exchange of genetic resources and related information. It is critical for countries to cooperate on activities such as collecting, exchange and evaluation, at both regional and international levels.

IPGRI's approach to its work reflects the interdependence of countries — and thus of country programmes — in genetic resources. Strong national programmes are needed to support a robust and effective multilateral system. In turn, an effective multilateral system will contribute to the strengthening of national efforts by greatly enlarging the range of benefits that countries might normally expect. These benefits include increased access to germplasm, to improved materials, to information and technologies.

Through its particular *modus operandi*, IPGRI assists individuals, organizations and institutions in partner countries to develop their abilities (individually and collectively) to set and achieve objectives, solve problems and better manage their genetic resources. As a result, they are more strongly positioned to contribute to — and benefit from — the global genetic resources effort.

IPGRI's collaborative approach addresses both the short-term and long-term needs of genetic resources research and management. In the short term, IPGRI helps to build the knowledge and skills needed to improve the performance of technical tasks, such as genebank management, genetic resources collecting, cryopreservation and *in situ* conservation, among others. IPGRI's work to enhance institutional capacity, build effective networks, and promote the establishment of supportive policy environments will help ensure that research programmes are sustained and genetic resources effectively managed in the long term. This annual report illustrates IPGRI's *modus operandi* by presenting some examples of our work.

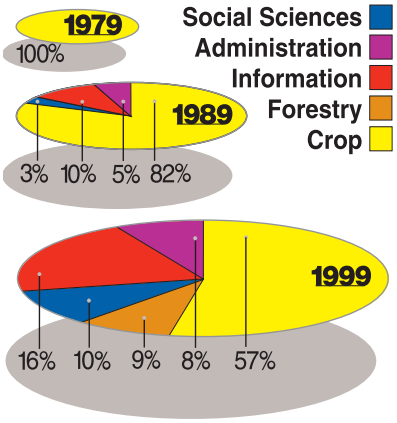
IPGRI'S *modus operandi*: honing a flexible response to a changing world

IPGRI is uniquely suited to playing a leadership role in the challenging and rapidly evolving field of genetic resources because of institutional characteristics that the institute has developed over the past 25 years, including:

- Diverse staff profile
- Decentralized organizational structure
- Emphasis on partnership.

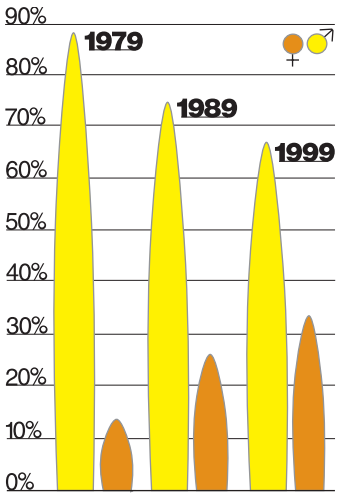
IPGRI's *modus operandi* ensures effectiveness in addressing problems of plant genetic resources, and flexibility in responding and adapting to changing needs and circumstances.

1. IPGRI professional staff disciplines



IPGRI's staff is an increasingly diverse group, which allows the institute to respond effectively to the needs of national programmes. In the early days of the institute, 100% of the professional staff were botanists and crop scientists. By 1999, the staff profile had changed significantly to respond to new priorities such as forest genetic resources, socio-economic and policy issues and information needs (chart 1). Reflecting the increasingly recognized role of women in science and development, the percentage of female professional staff has grown steadily from 13% in 1979 to 34% in 1999 (chart 2). Complementary staff, such as Associate Experts, Honorary Fellows, Interns and Visiting Scientists now make up approximately 17% of all staff. These professionals broaden IPGRI's skills base and add a further dimension of flexibility at significantly less cost than full-time senior professional staff. Honorary Fellows, for example, are senior level researchers engaged by the institute on a part time or limited term basis to address specific issues. IPGRI benefits from the high level of expertise brought by the Honorary Fellows, and also broadens its contact base by engaging experts from universities and institutes around the world.

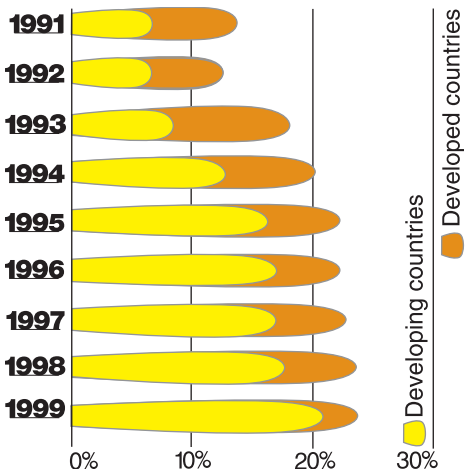
2. Gender of IPGRI professional staff



In addition to the IPGRI and INIBAP Headquarters in Rome and Montpellier respectively, there are five regional offices, four subregional offices and four regional INIBAP offices. In 1979, approximately 58% of all professional staff were located in Rome, whereas by1999, 60% were posted outside Rome. This decentralized organizational structure brings the institute closer to its partners and enables it to be more responsive to national and regional needs. Decentralization has also enabled the institute to recruit more staff within the regions where it works and to hire more professional staff from developing countries. Locally recruited professionals make an increasingly significant contribution to the institute, and now comprise approximately 22% of all staff. Three of IPGRI's regional offices and one subregional office are located with CGIAR centres. This helps build strong collaborative relationships with other CGIAR centres and increases efficiency within the CGIAR.

IPGRI does not maintain and manage its own laboratories but rather supports research carried out through networks of partner institutions, outsources research to other institutes, and carries out research using the research facilities of partner institutions. This approach facilitates joint priority-setting among many stakeholders and sharing of research costs among the partners involved, thus reducing the cost for any individual institute. At the same time it builds commitment, skills and infrastructure at the national and regional levels. From 1991 to 1999, between 13 and 24% of IPGRI's total budget has been "outsourced". Since IPGRI became an independent institute in 1994, this figure has remained between 21 and 24%. Partnerships have increasingly been established with developing countries, providing technical and financial resources to those countries where the needs are greatest (chart 3).

3. Outsourcing of IPGRI's budget



Institutional change

Strengthening national programmes in Africa

national programme development

Strong national programmes are the basis for effective genetic resources management. Nevertheless, approximately half of the countries responding to a survey conducted by FAO in 1995-96 had no formal national genetic resources programme in place. The situation is continually improving — by 1998 there had been a 40% increase in the number of countries that had established national programmes. However, many countries still lack the necessary financial resources, coordination and staffing to effectively conserve and use their genetic resources and participate in regional and international activities. In addition to essential technical know-how, there is a need for managerial skills and assistance in developing and implementing supportive policies.

IPGRI carries out a great many activities to help strengthen national programmes around the world. Training and workshops help develop skills in such critical areas as public awareness, communications, participatory planning and project management. IPGRI builds self-reliance in training for future scientists by helping to develop curricula and educational materials for use in short courses and university programmes. It provides technical assistance and direct funding to help build better research and conservation infrastructures. Finally, IPGRI promotes regional and international collaboration by participating in approximately 44 global and regional plant genetic resources networks.

IPGRI places a high priority on its work in sub-Saharan Africa and the institute supported many capacity-building activities in that region in 1999. For example, IPGRI helped to organize an

Stakeholders and partners in national plant genetic resources programmes

An effective national programme will address concerns and coordinate participation by these diverse groups.

Ministries:	Agriculture, Environment, Science and Technology, Trade, Forestry, Foreign Affairs, Culture, Energy, Tourism
Sectors:	agriculture, farming, environmental protection, research and development, education, business, trade, economics, intellectual property, forestry, rural development, nutrition and health
Institutions:	national agricultural research centres, genebanks, plant breeding stations, managers of protected areas, farmers' organizations, agricultural extension services, agricultural credit services, universities and colleges, research institutes, botanical gardens and arboreta, agri-businesses, export promotion agencies, import substitution agencies, marketing, forestry, land use planning
Stakeholders:	farmers, rural communities, plant breeders, biotechnologists, pharmaceutical industry, indigenous communities, traditional communities, scientists and researchers, domestic and foreign NGOs, domestic companies, foreign companies, foresters, extension agents, traders, urban consumers, rural consumers.

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international seminar in Germany for 22 national system leaders from 14 sub-Saharan African countries to discuss policy, planning and coordination. The workshop was financed by the German Ministry for Economic Co-operation and Development and facilitated by IPGRI and the Food and Agriculture Development Centre of the German Foundation for International Development (DSE).

IPGRI used the experience of the workshop to finalize a publication "Strengthening National Programmes for Plant Genetic Resources for Food and Agriculture: Planning and Coordination" which has been made available on the Internet and in print for distribution to national programme leaders and interested parties worldwide. A follow-up workshop is scheduled for May 2000 for member countries of the African network CORAF to help strengthen national programmes and regional collaboration.

In December 1999, with support from UNEP, IPGRI organized a workshop at Makerere University in Kampala, Uganda to enhance regional training expertise and collaboration. This workshop brought together five public universities and three national programmes from east Africa to discuss the establishment of an East African plant genetic resources training consortium. As a result of the workshop, existing training capabilities and gaps were identified, and a key list of contacts was developed. Recommendations were made to strengthen training and capacity-building within the East African Plant Genetic Resources Network (EAPGREN) and for specific activities, such as a training needs assessment, to be carried out once the network becomes operational.

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IPGRI supported many other capacity-building activities in Africa in 1999. For example:

- In Benin and Togo, IPGRI helped organize national plant genetic resources workshops, which raised awareness of the importance of plant genetic resources and led to the employment of new permanent staff within the national programmes.
- IPGRI participated in policy-level meetings in Uganda, and as a result, the government allocated funding to create a new Department of Plant Genetic Resources in the National Agricultural Research Organization.
- IPGRI assisted Cape Verde, Sao Tome and Principe to assess their genebank infrastructure needs and to develop a proposal for financial assistance. Subsequently, funding was provided by the Portuguese government for the procurement of material and supplies in each country.

Opposite page, Farmers' Day, Burkina Faso; this page, sorghum researcher, Ethiopia

Indicators of strong national programmes

1. Key decision-makers are aware of the importance of genetic resources management and conservation.
2. A wide range of partners is engaged in genetic resources decision-making, including as appropriate indigenous people, the poor, women, minority groups, rural and urban populations and government and non-governmental organizations.
3. National focal points or national committees are established.
4. Supportive policies are in place.
5. Complementary conservation strategies are developed and adopted between local, national, regional and international levels.
6. Increased or adequate budgets are allocated to genetic resources management and conservation.
7. Increased or adequate staff time within key institutions is devoted to genetic resources management and conservation.
8. Staff from key national institutions are well qualified and trained in genetic resources research and management and staff development programmes are in place to help keep staff skills up to date.
9. Genetic resources conservation facilities exist and are maintained to international standards.
10. National programmes participate in international and regional fora to address genetic resources conservation issues.
11. Genetic resources documentation and information management systems are in place.

Building national self-sufficiency in training

Continuous human intervention is needed if plant genetic resources are to meet their full potential to contribute to economic and social development. A wide range of skills and disciplines is needed to design and implement effective genetic resources programmes. Training is one of the most effective ways to help countries develop their capacity to conserve and use their agricultural biodiversity.

Yet, training in plant genetic resources is limited by lack of trainers and training materials, and of structured curricula for delivery. Graduate-level training in genetic resources management, which is becoming more common in developed countries, is not readily available to developing country staff, owing to costs and language barriers. And while more universities in developing countries are beginning to offer graduate-level training in plant genetic resources, many have limited staff and insufficient resources to sustain a graduate programme.

Developing-country scientists are often denied training opportunities or have difficulty using technical information because it is presented in a foreign language. IPGRI is conscious of the role of effective communication in achieving its mission and has increased the number of languages in which training is offered in order to reach a wider audience as well as to provide information that trainees can easily understand and apply to their work shortly after the training is completed.

IPGRI helps countries develop self-reliance in meeting their own training needs. One approach the institute takes is to work with university partners in all regions to increase their capacity to offer postgraduate-level training in the conservation and use of plant genetic resources. Its aims are both to increase the number of national staff with advanced level training, and to train trainers. IPGRI helps build this capacity by providing curricula and training materials for degree programmes on plant genetic resources, by supporting guest speakers to lecture in courses offered by national institutions, and by supervising thesis work.

With assistance and training resources provided by IPGRI, the Mexican Colegio de Postgraduados de Chapingo has set up a curriculum on plant genetic resources, which is linked to their graduate programme on genetics. The University of the Philippines in Los Baños and the Universiti Kebangsaan Malaysia have developed their curricula for graduate training in plant genetic resources with help from IPGRI. The University of Zambia and the University of San Carlos in Guatemala offer graduate courses on plant genetic resources with IPGRI-developed curricula and training materials, and with trainers trained by IPGRI. Guest speakers funded by IPGRI have lectured on a number of graduate courses offered by the Instituto Nacional de Investigaciones Agropecuarias in Chile.

For many years, IPGRI supported the MSc course on the conservation and use of plant genetic resources at the University of Birmingham, UK. Over the course of nearly two decades, 255 scientists from around the globe received some form of IPGRI support for their studies at Birmingham. In the past three years, IPGRI scientists have supervised around 20 MSc and PhD theses around the world.

Training summary 1999

Training is fundamental to IPGRI's efforts to strengthen national systems. During 1999, 738 scientists from institutions in 98 countries took part in individual and group training activities conducted by IPGRI in all regions. Group training events were held on a variety of topics, in major languages – English, Spanish, French and Portuguese — and in collaboration with national and international partner organizations.

Training provided by IPGRI (including INIBAP) during 1999

	No. of courses	No. of trainees	No. of countries represented
Group training	35	704	88
Individual training*		34	17
Total	**35**	**738**	**98****

* Including recipients of Vavilov-Frankel Fellowships

** Figures do not add up owing to overlap between countries represented in group and individual training categories

David Williams, IPGRI

IPGRI helps countries develop self-reliance in meeting their own training needs. Right, participants on an IPGRI-sponsored training course in Latin America

"Human development is ultimately a process of enlarging people's choices"

(United Nations Development Programme)

Lack of access to suitable course materials is a significant limiting factor in delivering effective training programmes. Training materials increase educational effectiveness, reach a wider audience than direct teaching can, and are a powerful way to assist national programmes to build staff capacity.

In collaboration with developing-country partners, IPGRI has produced modules for plant genetic resources training, based on a curriculum also developed by the institute (http://www.cgiar.org/ipgri/training/tsupport.htm). The training modules provide summary information and are easily adaptable to a trainers' particular situations and needs. The modules include slides, lecture notes, examples, references, a glossary and complementary documents. Their flexibility makes them convenient for use in short as well as diploma or degree courses. Taking advantage of new technologies, IPGRI will gradually make the training materials available to a wider audience, using both CD-ROM and web versions. The modules are also available in printed form.

Latin American scientists trained with materials developed by IPGRI

Topic	Trainees
Seed physiology	17
PGR utilization	35
Ex situ conservation	36
In situ conservation	14
Total	**102**

Spain has funded the development by IPGRI of five of the training modules in Spanish (see below). Over 100 Latin American scientists have already been trained with these materials, which are now being translated into Portuguese, with funds provided by Portugal. And institutions in Latin America and Africa have recently started to base national courses on the IPGRI training modules.

IPGRI training resources available

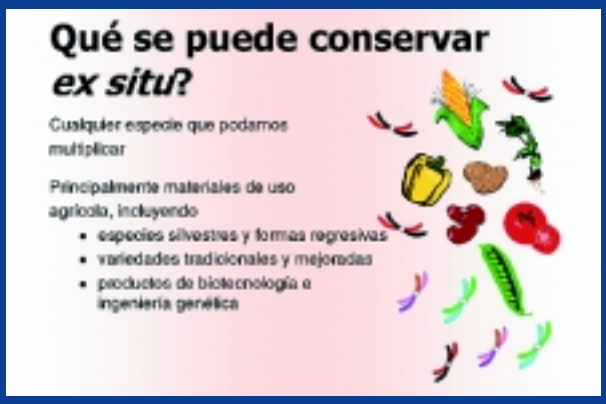
English (http://www.cgiar.org/ipgri/training/tsupport.htm)
- Curriculum on plant genetic resources
- Ecogeographic surveys
- Introduction to collecting
- Planning collecting missions
- Measuring genetic variation
- Data standards*
- Complementary conservation strategies*

Spanish and Portuguese*
- *Ex situ* conservation of plant genetic resources
- *In situ* conservation of genetic resources and wildlife species
- Seed physiology
- Plant genetic resources utilization
- Fundamentals of plant genetic resources

* In preparation

Over 100 Latin American scientists have already been trained with these materials

Examples of training materials for plant genetic resources developed for a Spanish-speaking audience



Getting more juice out of tropical fruits

A productive and diverse agriculture can help reduce the effects of rural and urban poverty. However, the role that tropical fruits can play to diversify diet and generate income for developing countries has not received much explicit recognition. IPGRI is trying to change that by helping farmers in Africa, Asia and Latin America to use their native fruit diversity — estimated at about 3000 edible species — to open new markets for fresh and processed fruits.

Wild *Musa* varieties

IPGRI

Only a few tropical fruits (banana, *Citrus*, mango, pineapple, papaya and avocado) are cultivated on a large scale. Most others are still grown in home gardens or collected from the wild for direct consumption or for sale in local markets. While many developing countries are striving to increase the production and quality of their tropical fruit crops in order to compete in international markets, their efforts are often undermined by substantial losses from diseases, pests and inadequate post-harvest handling.

Yet tropical fruits have a promising market outlook that justifies efforts to develop them. According to an FAO study based on projections for the market leaders – banana, mango, pineapple, avocado and papaya — which currently account for over 90% of exports, the global demand for tropical fruits is expected to increase by 40% by 2005. The potential clearly exists to expand the world's fruit basket to include more species, but these will need to meet export standards — a challenge for research, which has traditionally focused on breeding a few species.

A major starting point in the search for alternative profitable crops is assessing and conserving the target diversity from which farmers and breeders select materials for improvement. IPGRI is supporting countries around the world to measure the diversity of fruits of regional economic importance. Based on their export potential, countries in Latin America have given priority to pineapple, passion fruits, sapotes and papayas, while those in Asia have selected mango, citrus, litchi, rambutan, jackfruit and durian. In Central and West Asia and North Africa, priority has been given to almonds, pistachio, pomegranate, data palm, olives and carob. IPGRI has carried out, in collaboration with national institutes, research to improve the conservation and use of the genetic resources of these crops.

Progress has been promising on all fronts. Selected material of mamey zapote (*Pouteria sapota*), evaluated in a project coordinated by IPGRI, has already been made available to Central American growers to expand their commercial production. PROFRUTA (Proyecto de Desarrollo de Fruticultura y Agroindustria), a programme of the Guatemalan government that provides technical assistance to set up and manage orchards, adopted the descriptors developed through the project to select trees from which to produce planting material of mamey zapote and meet a demand estimated at 45 000 plants. Pineapple growers in the Americas are reducing their losses with materials found to resist fusariosis — the crop's most devastating fungal disease. Both growers and consumers will benefit from the new pineapple types, selected from materials collected in the Amazon Basin and evaluated with IPGRI assistance.

'Curuba India'(*Passiflora tripartita* var. *mollissima*), a new species of the so-called "banana passion fruit", was identified in a project coordinated by IPGRI and CIRAD-FLHOR and found to resist anthracnose. The new species, previously thought to be a variety of *Passiflora mollissima*, is now a valuable market alternative to the highly susceptible variety 'Curuba de Castilla'. The new hardy and longer-yielding species could represent a source of steady income for Andean farmers.

Crops, like mango or litchi, whose seeds are sensitive to dehydration and low temperatures, cannot be stored for long periods. Neither can those, like pineapple, that propagate vegetatively. Cryopreservation, the very low temperature storage method described elsewhere in this report, is a safe and cost-effective option for conserving these crops on a long-term basis. Joint efforts by IPGRI and institutes in Asia, Africa, the Americas and Europe to develop cryopreservation practices for fruit species have already given positive results with pineapple, citrus, jackfruit,

tropical fruits

Tropical fruit facts

Silvestre Silva

Ripe sapote fruit on sale in a south American market

Sapotes (*Pouteria sapota*, *P. viridis*, *P. campechiana*, *Manilkara zapota* and *Chrysophyllum cainito*)
Sapote trees grow in home gardens in Mexico, Central America and the Caribbean. They are valued for their delicious fruit as well as for their seeds, wood, bark, latex and leaves. The fruits are sold in local markets and frozen fruit pulp is exported to the United States. Most fruit is consumed fresh or in soft drinks and ice cream. Annual harvests can reach a few thousand tonnes per country but fruit fly attacks can cause losses of up to 95%. Some of the many known sapote varieties have a wonderful flavour, others have resistance to the fruit fly, but most of them have a short shelf life. Because of a lack of improved varieties and inadequate market development, sapote trees are being cut to use their wood in construction or to plant more profitable crops.

Passion fruits (*Passiflora* spp.)
The genus *Passiflora* includes around 400 tropical species, some with great potential for international markets. Passion fruit pulp is good in marinades, sherbet, juice, salad dressing, and as dessert topping for ice cream and cakes. Some passion fruits, which are traditionally grown in home gardens or collected from the wild, are falling into disuse despite their economic potential. Wild species may contain useful characteristics including vigour, high fruit production, climatic and ecological adaptability, fruit quality, colour and flavour, and resistance to many diseases. However, many of these are also threatened — by urbanization and wild habitat degradation.

Mango
Mango (*Mangifera indica*), cultivated in India for over 4000 years, is one of the most highly esteemed fruits of the tropics. It is grown in the tropical and subtropical lowlands of the world. The fruit is rich in vitamins A and C and is used in many ways, fresh consumption being the most important. Commercial production requires resistant varieties: the crop is highly affected by diseases and pests, which are still controlled with chemicals. A few mango species (*M. foetida, M. odorata, M. caesia* and *M. kemanga*) are either cultivated or extracted from the wild in Southeast Asia.

Citrus (*Citrus* spp.)
This popular group of edible fruits encompasses lemon, lime, citron, sweet and sour oranges, grapefruit and mandarins. Almost all species are native to southeast Asia, Indonesia or Malaysia. Citrus fruits are rich in vitamin C, fruit acids and fructose, and essential oils are found in the rind and fragrant blossoms of some species. Despite their Asian origin, over 80% of the world's citrus fruits are produced in the Mediterranean and the Americas. But the Asian countries have excellent possibilities to enhance and use citrus fruits.

I. deBorhegyi, IPGRI

Despite their Asian origin, over 80% of the world's citrus fruits are produced in the Mediterranean and the Americas

Paul Quek, IPGRI

papaya and passion fruit. In future this research should result in an increasing number of tropical fruits that can be conserved using this technology.

Over time, IPGRI and its partners have accumulated a wealth of information on promising fruit crops. IPGRI reports are now available on the status of conservation and use of mango, citrus, rambutan, jackfruit, durian and litchi in 15 Asian countries. A bibliography (containing 677 records) of fruits native to the Americas has been recently released and an electronic inventory is being developed, which covers over 1000 tropical American fruits. This information will gradually be made available on IPGRI's web pages to facilitate additional research.

By supporting research on tropical fruits and promoting their conservation and use, IPGRI is providing developing-country farmers with options to diversify agriculture and sustain their income, and offering consumers worldwide a more diverse and nutritious diet.

Tropical fruit. Top, wild durian in east Kalimantan; below, breadfruit

Jean-Marc Bompard, IPGRI

Using networks to enhance conservation and use of plant and forest genetic resources in Europe

The benefits of collaboration in genetic resources have brought many countries together in partnership over the years. IPGRI has long been a driving force in developing networks to link the genetic resources activities of national programmes, research institutes and others. Networks are inspired by common interests. Members might share an interest in the genetic diversity of a particular species, or they might share ecological conditions and a common concern with a range of different species. Some networks are based on a mutual interest in a particular thematic research area, such as *in situ* conservation.

Today, about 150 countries are involved in one or more of the genetic resources networks that exist around the world. Networks provide a mechanism for members to share resources, ideas, technologies and information. They have become an efficient way for countries to divide the responsibilities and costs of training, conservation and technology development, and to promote the establishment of joint conservation strategies. In some ways, the concept of a multilateral system for genetic resources exchange has its origin in the ability of networks to deliver significant benefits to members.

Established nearly 20 years ago, the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) is one of the oldest of the genetic resources networking programmes. ECP/GR provides an umbrella for 10 networks supported by 33 European countries. IPGRI hosts the secretariat for the Programme.

The ECP/GR Networks focus on:

- **Cereals**
- **Forages**
- **Vegetables**
- **Grain Legumes**
- **Fruit**
- **Minor Crops**
- **Industrial Crops and Potato**
- **Documentation and information**
- ***In situ* and on-farm conservation**
- **Inter-regional Cooperation**

IPGRI

ECP/GR monitors and mobilizes support for emergency situations throughout Europe. In Albania, valuable collections of grapevine (*Vitis*) genetic resources were gravely at risk owing to the continuing socioeconomic crisis in that country. Cultivated fields were abandoned, including the vineyards where the local varieties of grapevine once had been planted. With ECP/GR support, IPGRI organized a rescue mission, which resulted in the recovery of more than 100 *Vitis* accessions, including 60 local varieties. A temporary field collection was established in Friuli, Italy, with help from the Università di Milano, the Fruit Tree Institute in Vlora, Albania and IPGRI, with plans to eventually restore the regenerated material to Albania. Now, with the benefit of the experience gained from the Albanian project, a similar effort to re-establish the grapevine collection has been launched in Georgia, the country of origin of *Vitis*.

The ECP/GR Programme is also helping east European and other non-EU countries to contribute to and benefit from genetic resources projects funded by the European Union. Regulation EC1467/94 provides support for genetic resources activities in member countries of the Union. A number of projects on different crops funded within this Regulation actively collaborate with the ECP/GR networks. For instance, ECP/GR supported the involvement of Hungary, Czech Republic, Ukraine, Russia and Poland in the EU project on potato genetic resources. As a result, local potato germplasm from these countries has now been characterized and evaluated and the data have been sent to the European Central Potato Database. The EU-funded project on beet benefited from the participation of the Czech Republic, Poland and Russia, thanks to support from ECP/GR. Local germplasm has been characterized and evaluated and the resulting data included in the International Database on Beet.

EUFORGEN - the European Forest Genetic Resources Programme - which is coordinated by IPGRI, operates through networks devoted to five important European groups of forest tree species: Conifers, Mediterranean Oaks, Black Poplar (*Populus nigra*), Noble Hardwoods and Social Broadleaves. EUFORGEN network members include forest geneticists and other forestry specialists from about 30 countries, whose concern is to develop and promote conservation strategies and methods for these species.

Working together, the EUFORGEN networks developed a series of tools for the sustainable management of forest genetic resources. For example, technical guidelines for conservation of the genetic resources of Norway spruce - which have been distributed to forestry officers throughout Europe - provide advice on management practices used in various site conditions, the optimal size of populations, regeneration models and timeframes necessary for both *in situ* and *ex situ* conservation.

The Black Poplar Network, which is one of the most active of the EUFORGEN networks, has established a collection of clones from 20 European countries. The collection includes two representative specimens from each country and is used for both research and public awareness purposes. Requests for full replicas of the collection have come from several research institutions, including one in China. A database of clones provides information on all the main collections of *P. nigra* in Europe. The number of acces-

Opposite page, a mature species mixed mountain forest. This page, right to left, mature trees, sprouting seed, fruit and buds of the beech tree *(Fagus sylvatica* L.). All photos courtesy of the Social Broadleaves Network members.

sions in this database has increased by 30% since it was made available on-line two years ago. The Network also developed an "identification sheet" - now available in seven European languages - to help forestry experts recognize Black Poplar species in the wild.

The impacts of the networks often go beyond their immediate outputs. The Balkans are home to broadleaved forests characterized by significant natural genetic diversity of oaks, beech, maple, lime, elm and wild fruit trees. But improper forest management, excessive logging, pollution and repeated droughts, combined with diseases and pest attacks, have led to the decline of many stands. Now, a project funded by the Government of Luxembourg is bringing together EUFORGEN partners from Bulgaria, Moldova and Romania in an effort to conserve these unique stands.

With IPGRI's support, the countries developed distribution maps of nine broad-leaved species, using GIS and local inventories. These maps are now being used by forest services and researchers. Databases of gene conservation units, providing precious information on the existing resources, were also compiled and technical guidelines for conservation and use in local languages were provided by the project. New methods for *in vitro* conservation have been developed in collaboration with a research centre in Luxembourg - the Centre de Recherche Public Gabriel Lippmann - another partner in the project. These propagation methods often represent the only way to regenerate the genetic material of native, endemic oak species in southeast Europe.

One important benefit of the network approach is that it protects partners from duplicating efforts and wasting their resources. Research needs and priorities are discussed and methods for improving coordination agreed upon during EUFORGEN network meetings. These discussions have led to the development of several joint projects, including studies of black poplar diversity in European floodplains, conservation of elm genetic resources, and a cork oak provenance experiment.

Similarly, a project proposal on European plant genetic resources information infrastructure was jointly developed and submitted last year by partners through the ECP/GR Information and Documentation Network. To date, European central crop databases providing data for 250 000 accessions in 40 crops have been compiled by the different ECP/GR networks. A large part of the information is already available on-line from the European Information Platform on the Internet.

The success of the European genetic resources networks suggests that the potential exists for linking them to other regions of the world. ECP/GR has established an Inter-regional Cooperation Network which held its first consultative meeting in 1999. The goal of this new network is to facilitate the exchange of information and expertise between Europe and other regions.

Linking scientists and farmers to strengthen agrobiodiversity conservation

An IPGRI project is forging lasting partnerships between researchers and farmers in nine countries in order to strengthen the conservation and use of local crop varieties.

The project seeks to understand the nature of genetic diversity conservation at the local level. By drawing on knowledge and experience from around the globe, researchers hope to strengthen the science behind the *in situ* conservation and use of local crop diversity, and to facilitate learning processes at local, national and global policy levels. This information can be used to support sustainable agriculture and the improvement of farmers' livelihoods.

The project's goals are threefold:

- to link institutes, disciplines and stakeholders
- to collect and analyze information about farmers' maintenance of local cultivars
- to use that information for social, economic, ecological and genetic benefits.

The nine countries involved in the project are Burkina Faso, Ethiopia, Hungary, Mexico, Morocco, Nepal, Peru, Turkey and Vietnam. Each is situated in a region of primary diversity for crops with global importance. Each has a national plant genetic resources programme and traditional farming communities that maintain plant genetic resources, conditions that favour the project's aim to promote the integration of on-farm conservation practices into national programme activities.

Multidisciplinary research in the areas of socioeconomic influences on farmer decision-making, natural and environmental selection factors, plant population structures, the agromorphological selection of traits by farmers, and seed supply systems will probe the relationships between natural and human factors and the level of crop genetic diversity that is found in farmers' fields.

In Nepal, for example, preliminary studies have revealed that variation in farm households' wealth status contributes to diversity in rice landraces at the community level. Wealthier households maintain a significantly higher number of landraces, cultivating aromatic and superior varieties like *Jetho Budo* and *Pahele* for their premium market prices and fine cooking qualities. Less well-off households maintain different landraces, particularly those adapted to low-input, rain-fed conditions. Other varieties are grown by many households of all wealth groups in small patches because of their cultural, medicinal and religious importance. A next step in the project will be a genetic analysis of these landraces to determine quantitatively the amount of genetic diversity they represent.

Researchers in the Yucatán, Mexico are using farmers' knowledge and empirical testing to characterize maize landraces and to investigate whether farmer-named varieties define units of genetic

Researchers and farmers are working together with IPGRI to conserve local crop varieties in nine countries. Below, drying cloves in southeast Asia; opposite page, south American crops, including amaranthus, maize and sorghum

in situ conservation

diversity. Linguistic studies revealed that farmers' Mayan names for landraces recognize important defining traits, such as grain colour and length of vegetative cycle. Nutrient analyses of landraces for carbohydrate, protein, and fat content highlighted the differences in the chemical composition of these varieties. Empirical measurements of agromorphological characteristics further illustrated the differences between varieties and races of maize. Principal Component Analysis was used to determine that only seven agromorphological characteristics accounted for over 85% of the variability within 15 maize landraces. In addition, studying farmers' names for landraces, and their management and food-preparation practices will increase scientists' understanding of the criteria farmers use to select the varieties they plant.

The agromorphological traits used by farmers to identify and select their landraces were assessed under different crop management practices in Morocco. Farmers identified the important traits to be measured, and scientists took empirical measures, both in farmers' fields and through field trials on research stations, of agromorphological characteristics and agronomic performance for landraces of durum wheat, barley, faba bean and alfalfa. Analysis of the collected data will allow a better understanding of how farmers' management practices influence the traits that they use to select varieties of these crops, and how different traits vary in importance between different farming systems.

Such multidisciplinary research activities are being employed to identify the best conservation strategies for particular crops in the nine countries. Analysis of the information will help to identify farming systems practices where the use of local crop resources improves ecosystem health, and to discover factors limiting the maintenance of local crop diversity on-farm. The information will also help breeders to improve varieties for marginal environments and to link breeding efforts with farmers' needs.

Future *in situ* conservation research will investigate what methods can be used to add benefits to landrace production and to support farming systems associated with high genetic diversity. Farmers will continue to maintain crop genetic diversity in their fields only as long as the opportunity cost of forgoing other options - which may be relatively large or small, according to the economic conditions they face - remains sufficiently low. Strategies for enhancing the benefits of crop diversity for farmers include improving the landrace materials and production systems in which they are grown, increasing farmers' access to a diversity of varieties, and increasing consumer demand for products made from local landraces. Based on the collection and analysis of information in IPGRI's project, *in situ* conservation programmes will be better equipped to design appropriate strategies, which may differ on a community-by-community basis.

Both photos by Devra Jarvis, IPGRI

Conserving genes at ultra-low temperatures

Traditional approaches to genetic resources conservation have relied on the *ex situ* storage of seeds, where the seeds are dried and stored at low temperatures in genebanks. However, scientists have faced difficulties with species that are seedless, such as most types of banana, with species that are vegetatively propagated, such as potatoes, and with those, such as mahogany or mango, which produce seeds that die when dried or chilled. These latter seeds, which are called "recalcitrant" to describe their lack of response to standard storage conditions, are common in many tropical or subtropical woody species. Now, with help from IPGRI, a high-tech but low-cost conservation method holds out promise for a significant number of important, but difficult to conserve, species.

Classically, "problem" species, such as those described above, have been conserved as whole plants in field genebanks. However, some people question the effectiveness of field genebanks because they leave genetic resources exposed to natural disasters and to attacks by pests and pathogens. They can also be costly. To avoid such problems, scientists have searched for alternatives to conservation in the field.

Cryopreservation is a promising technique that stores plant tissues or seeds at very low temperatures in liquid nitrogen (at or near -196° C). Because all metabolic processes and cell divisions are arrested at such low temperatures, the material can be stored for extended periods, with very limited technical maintenance beyond periodic replenishment of the liquid nitrogen.

IPGRI strongly promotes cryopreservation because of its potential for greater security and cost-effectiveness. Preliminary data from a comparative study carried out by the United States Department of Agriculture show that maintaining temperate fruit trees in field genebanks costs approximately $77 per year compared with $1 per year when they are cryopreserved.

Cryopreservation

Cryopreservation is a secure and cost-effective storage technique for many crop species. IPGRI has promoted research to cryopreserve important tropical species such as yam, almond, litchi, jackfruit and breadfruit

IPGRI is also funding a joint project between Spain and Cuba on the cryopreservation of citrus genetic resources. A cryopreservation protocol has been developed for apices of three different *Citrus* species, with survival rates ranging between 36 and 55%.

CIMMYT

Cryopreservation

While cryopreservation has been around since the 1970s, there is still much to learn. Methods for preparing cultures for cryopreservation need to be worked out for many species and even, in some cases, for individual varieties.

Dramatic progress has been made in recent years, however, to refine cryopreservation techniques and to extend their use to a greater number of species. In China, for instance, IPGRI has promoted the development and use of cryopreservation through training and research support. For over a decade, with support from IPGRI and the Chinese government, the Changli Institute of Pomology has been studying new methods for cryopreserving the genetic resources of the national fruit collection.

IPGRI and the Italian government collaborated in 1996 to provide training in cryopreservation for a Chinese researcher from the Changli Institute at the Istituto Sperimentale per la Frutticoltura near Rome. To capitalize on this training, IPGRI funded a four-year research programme to develop and apply cryopreservation methods for pear, grape, sweet cherry and kiwi. Survival rates of 49 to 75% were found for the different species, showing that the achievement of useful levels of survival is possible for a broad range of fruit tree species. The results have been published so that other researchers can learn from them and the Changli Institute has begun to train Chinese researchers in these new methods of cryopreservation.

Collaborating to promote cryopreservation in India

Working closely with the National Bureau of Plant Genetic Resources (NBPGR), IPGRI is promoting the generation of new knowledge about cryopreservation in India, developing institutional capacities to conduct cryopreservation research and conducting training to build skills in the technique.

The partnership allows the two institutes to make the most of each others' financial, infrastructure and staff strengths. NBPGR provides laboratory facilities, support staff and technical supplies and has assigned two staff scientists to the research effort. IPGRI acts as a liaison between the national programme and interested donors, provides technical assistance to the design and implementation of the research, sponsors staff training, and helps Indian researchers present and publish their results.

When the joint project began in 1995, cryopreservation techniques existed mainly for cold-tolerant temperate species. Now, these techniques have been developed for several important tropical crops, including yam, almond, litchi, jackfruit and breadfruit.

From conservation to use: putting plant genetic resources to work

Use of plant genetic resources

The 1998 FAO report on *The State of the World's Plant Genetic Resources for Food and Agriculture* found a general consensus among countries that greater use could be made of conserved plant genetic resources. The report cited constraints to greater use, including lack of characterization and evaluation data about conserved materials, insufficient documentation about what genetic materials are being conserved and where, poor integration between genebanks and the users of germplasm, and poor coordination of policies at the national level.

IPGRI promotes greater use of genetic resources through a number of activities. For example, IPGRI hosts the System-Wide Information Network for Genetic Resources (SINGER) to increase the quality and range of data about germplasm collections. SINGER is a project of the System-wide Programme on Plant Genetic Resources (SGRP). IPGRI also develops standards and guidelines for genebank management and related information systems, supports farmer's participation in breeding and *in situ* conservation, and coordinates crop networks, such as the International Network for the Improvement of Banana and Plantain (INIBAP) to increase collaboration on genetic resources conservation and use. As a complement to its technical activities, IPGRI promotes supportive genetic resources and related policies at the national and international levels, and works to increase awareness of the importance of genetic resources in human development.

Recently, IPGRI supported three studies to find out more about the use of genetic resources. In the first study, the Chinese Institute of Crop Germplasm Resources analyzed the use, between 1984 and 1998, of the rice, wheat, soyabean, maize, cotton, orange, tea, mulberry, cabbage and cucumber germplasm conserved in China's national genebanks. Researchers found that a total of 184 743 accessions were distributed to 8635 institutions during the period and that the accessions were used in crop breeding, basic research, production and teaching. Most of the materials distributed were bred varieties, breeding lines, or landraces. Of the landraces, 178 were directly used in agricultural production on over 12 million hectares. These landraces were selected for cultivation because they possessed desirable traits such as disease resistance, large grain size and stress tolerance.

In the second study, IPGRI surveyed all articles published during 1996 in four internationally recognized journals publishing research on agricultural genetics (*Crop Science*, *Euphytica*, *Plant Breeding* and *Theoretical and Applied Genetics)* to assess the use of conserved plant genetic resources in current agricultural research. Almost one quarter of the published research used conserved germplasm, mainly to analyze genetic diversity

Recommendations

A number of recommendations arise from the FAO report and the IPGRI studies about how to increase the use of genetic resources:

- Priority should be given to characterization, evaluation and in-depth research on conserved germplasm.
- Exchange of information about germplasm should be encouraged through networks and other means.
- Cooperation between germplasm holders and users should be encouraged.
- Farmers should be encouraged to make direct use of landraces and other materials conserved in genebanks.
- Training in plant breeding should be strengthened.
- National plant genetic resources coordination mechanisms should be established.
- Regulatory frameworks, policies and legislation should facilitate greater use of genetic diversity.

From conservation to use. Conserved genetic material is used for breeding new and better varieties

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among accessions and inheritance of characteristics such as pest and disease resistance. The germplasm originated from collections housed in genebanks in 27 countries and 7 CGIAR Centres. Approximately 16% of the material originated from CGIAR Centres 75% from developed countries, and 9% from developing countries. Almost all of the research described in the journal articles was conducted by national research centres and universities — very little by private enterprises — and approximately 20% of the research took place in developing countries.

The third study is tracing the use made between 1980 and 1995 of the germplasm of forages, beans and cassava stored in the genebank of the Centro Internacional de Agricultura Tropical (CIAT). Preliminary results show that more than half of all bean accessions and approximately 42% of the groundnut accessions held in trust by the CIAT genebank were distributed for use between 1980 and 1995. CIAT's bean germplasm was distributed to 222 institutions in 64 countries and groundnut germplasm to 82 institutions in 34 countries.

CIMMYT

I. DeBorhegyi, IPGRI

Above, making wide crosses from primitive varieties during wheat breeding work at CIMMYT; below, varieties of *Citrus* on sale in a West Sumatran market specifically for use in magical treatments

Strengthening conservation through use: the role of home gardens

Home gardens are rich in the genetic diversity that increases economic options, dietary variety and nutritional levels for households throughout the developing world. Located at the heart of domestic activities, they often feature a variety of crops that meet household needs for food, medicines, utensils and fuel. Home gardens may also contain cash crops such as spices, which can provide important secondary income.

Because home gardens have to meet so many different family needs, they tend to contain high levels of diversity among and within species — diversity that may be disappearing from large-scale agricultural systems and the wild. For this reason, home gardens can be a means of conserving the genetic diversity of certain crops. IPGRI has taken a leading role in promoting home gardens and in increasing knowledge about the contributions that they make to biodiversity conservation, and about the link between diversity and family income and nutrition.

Researchers have found that home gardens can be an important source of household income — especially for the women who typically manage them — when surplus produce or cash commodities, such as fruit, medicinal plants, tea and spices, are sold. For example, clove production in home gardens in Sri Lanka was found to contribute an average of 42% of farm income. A study in Vietnam showed that income per unit area from home gardens could be up to three times higher than income from rice fields.

Home gardens contribute to a household's food supply by increasing the availability of low-cost or no-cost foods. In the Philippines, a survey by the Food and Nutrition Institute found that 20% of the food consumed by families came from home gardens. In some countries, more than half of low-income urban households supplement their diets with food grown in home gardens. The gardens also tend to provide food year-round, which fills gaps in food supply during lean periods.

As important as home gardens are, they have been relatively neglected by agricultural research and development efforts. In 1998, IPGRI developed a research project to link the income and nutritional benefits of home gardens with the unique inter- and intraspecific diversity they contain and to evaluate their potential role as viable conservation areas within farming systems. The project aims to develop strategies for conservation through use, which would help families reap the benefits from home gardens while maintaining their unique genetic diversity.

Project teams in Guatemala, Venezuela, Cuba, Vietnam and Ghana are collecting data about agricultural biodiversity in home gardens and surveying farmers about the limitations they face in maintaining the gardens. The teams are looking at economic, cultural and genetic factors associated with home gardens and their use.

Preliminary research results confirm the richness of the diversity found in home gardens. In Vietnam, for example, home gardens averaging less than half a hectare in size were found to contain an average of 68 different species. Home

Daniel Debouck, CIAT

home gardens

gardens in Java were found to contain up to 10 different varieties of cassava, each grown for their specific characteristics of importance to the family. Home gardens also reflect the cultural background of the household. Cuban home gardens often contain crops of African, European and Asian origins, often grown together with root and tree crops indigenous to Cuba. In Guatemala, the study found that species diversity was significantly higher in home gardens managed by indigenous farmers than in those of non-indigenous farmers.

Tapestry showing a typical Colombian home garden in the Andean hillsides IPGRI

In Vietnam, researchers found that national policy greatly influenced the diversity and composition of home gardens. During that country's era of centralized planning, cooperative farms were directed to grow only a few varieties of one or two species. Farmers moved their valuable, traditional crops into home gardens, which became reservoirs of diversity. Now, Vietnamese policy allows farmers to choose what to plant and, as a result, farmers are expanding the production of varieties originating in home gardens into areas previously reserved for cooperative farms. However, questions remain about how the policy change will affect overall diversity, since farmers are also expanding the commercial production of fruit tree species.

One way in which IPGRI's work will help maintain home garden diversity is by encouraging the integration of home gardens into national biodiversity conservation strategies. The research process itself has been important since it has brought together, in many cases for the first time, national genetic resources programme researchers with native communities, farmers' and community associations, and development workers to evaluate the composition and use of home gardens. This collaboration and the knowledge it generates will be the basis for future efforts to conserve and use the diversity found in home gardens.

A book based on the work of IPGRI's home garden project will be published in 2000 in association with the Smithsonian Tropical Research Institute and Smithsonian Press. A particular focus of the book, entitled *Home Gardens and Agrobiodiversity,* is how the relationship between ecological, cultural and market factors affects choices about the use of species and varieties in home gardens. The book is also a rich source of information about the collaborative research methodologies employed in the project, which will help future researchers undertake similar initiatives in other countries.

Werner Ovando

Opposite page. Maize, beans and squashes are typically grown together in Mesoamerican home gardens. This page. A Mayan farmer in Guatemala showing the medicinal plant Bajlaj Ché (*Catopheria chiapensis*). Medicinal crops are important components of Mayan home gardens and are essential for the health and well-being of the members of the household

The value and usefulness of underutilized crops

Geoff Hawtin, IPGRI

Humankind relies on a wide diversity of plants. At least 5000 species are cultivated for food, shelter, medicinal and other purposes. Until now, agricultural research has focused on major staples, a much smaller number. Yet, the value and usefulness of so-called minor or underutilized crops are well recognized at regional and local levels where they often play an important role in household nutritional security, for example through providing vitamins and micronutrients. Many of these species are adapted to farming conditions that are unsuitable for 'major' crops, such as zones with saline soils, arid conditions, or degraded or hilly areas. Indeed, in some cases, they are the only crops that can be grown. Reflecting the central role they often play in poor people's lives, minor crops are closely tied to the history and cultural identity of the communities that have grown them for centuries.

Despite their importance, these species have been largely neglected by researchers. Information on their cultivation is often lacking, there is little genetic diversity available in genebanks for breeders to use, and the seed industry is reluctant to invest in the commercialization of a niche crop. Meanwhile, as more people migrate to the cities, minor species are falling into disuse, putting them at risk of genetic erosion or even extinction.

In many cases, the potential exists for more widespread use of these species. They include crops that could meet the needs of consumers seeking a more natural and varied diet. They can offer opportunities for farmers to tap into diverse markets and thus represent important new sources of income for rural people.

These were some of the conclusions of a workshop hosted by the MS Swaminathan Research Foundation in Chenmai, India with support from IPGRI and the CGIAR Genetic Resources Policy Committee in 1999. The workshop examined the potential role of the CGIAR in enlarging the world's food basket through greater use of underutilized species.

IPGRI has long had an interest in underutilized species. In particular, the institute works on species with a strong potential for increasing income-earning opportunities among poor people. A project to promote the conservation and use of underutilized species native to the Mediterranean basin has helped to raise awareness of the potential market value of crops such as rocket, hulled wheats, pistachio and oregano while contributing to their *in situ* and *ex situ* conservation.

In Central Asia, where pistachio has been regarded mainly as a forest tree species rather than as a source of nuts with strong market potential, countries are now joining forces to exploit this neglected crop through an effort coordinated by IPGRI's CWANA Office in Tashkent, Uzbekistan. Pistachio and its wild relatives are drought-tolerant and can thrive in poor soils, making them particularly suitable for cultivation on marginal lands. Ecogeographic surveys and germplasm collecting missions are being planned in Central Asia to learn more about the diversity, distribution and uses of pistachio and to strengthen their conservation.

Uzbekistan is home to an important array of wild and cultivated vegetable diversity. IPGRI sponsored a series of collecting missions in 1999 to collect endangered cultivated species of eggplant, watermelon, turnip, celery, nigella, carrots, radish, basil, coriander, sesame and cabbage, along with their wild relatives, and to learn about conservation and use of these species from the farmers. During one mission, the collecting team met with an old farmer whose life commitment to local crop varieties has led him to safeguard more than 100 melon varieties on his farm! Another IPGRI-supported mission uncovered rare fruit tree varieties still being maintained by farmers in Afganistan. A germplasm catalogue to properly document this diversity, including unique apricot and almond landraces, is currently under preparation.

The countries of the Asia, Pacific and Oceania region have identified buckwheat, safflower, sesame, lathyrus and taro as minor crops requiring priority attention. Crop networks have been established to foster collaboration between countries on the genetic resources of these crops.

T. Grennan, IPGRI

Pablo Eyzaguirre, IPGRI

Stefano Padulosi, IPGRI

Underutilized crops play an important role in sustaining households in marginal rural areas. IPGRI promotes the conservation and use of neglected species such as taro, safflower, pomegranate as well as Andean roots and tubers. Opposite page, safflower, Indore, India. This page: left, taro plants in southeast Asia; above, IPGRI project staff studying taro *in situ*; below, pomegranate in west Asia

The *in situ* project coordinated by IPGRI and described elsewhere in this report is focusing on buckwheat as a key Asian crop requiring further research attention. The project is studying the feasibility of on-farm conservation of bitter buckwheat in the mountains of Nepal and Southwest China and gathering social and economic information on production and seed systems, including selection criteria and distribution of the crop. IPGRI assisted the Safflower Network to develop an electronic catalogue, which contains detailed information on about 2000 accessions of safflower held in 22 institutes in 15 countries around the world. The catalogue is being tested and will be available soon. Similar catalogues are under development for *Lathyrus*, a drought-resistant legume, and for sesame. IPGRI helped China and India to develop core collections of sesame and is currently assisting South Korea to do the same.

The root crop taro (*Colocasia esculenta)* is an important food in many parts of the tropics, especially in the Pacific. IPGRI is providing technical and scientific support to the Taro Genetic Resources Network (TaroGen) as well as to the Taro Network for Southeast Asia and Oceania (TANSAO). IPGRI assisted TaroGen to collect taro diversity in Papua New Guinea and the Solomon Islands and to establish a Regional Germplasm Centre. IPGRI collaborated with the Ministry of Agriculture, Fisheries and Forests in Fiji to establish a pilot *in vitro* genebank for taro and a field genebank at the Koronovia Research Station. In future,it is hoped to set up an *in situ* conservation effort for taro in Vanuatu.

In West and Central Africa, IPGRI is working to improve the management of root and tuber crops such as yam (*Dioscorea rotundata*), frafra or Hausa potato (*Plectranthus rotundifolius*) and cocoyam (*Xanthosoma sagittifolium*) by farming communities and development institutions. IPGRI researchers surveyed farmers in the Upper East and West Regions of Ghana to gather information on their strategies for conservation and use of the frafra potato, a tuber eaten throughout West Africa. Samples of this important local crop are being regenerated at the Plant Genetic Resources Center in Bunso, Ghana and stem cuttings have been harvested for introduction into tissue culture. Studies to determine the optimal conditions for dehydration and the freezing tolerance for cryopreservation of root and tuber crops were initiated in collaboration with the University of Ghana. A series of experiments are seeking to determine the optimal slow growth conditions for *Dioscorea rotundata* (four genotypes), *Plectranthus rotundifolius* and *Xanthosoma sagittifolium*.

IPGRI has worked closely with CIP for several years on a project to conserve species of Andean root and tuber crops. Specifically, IPGRI's Americas office has supported the 14 genebanks involved in the project to assess and improve the documentation of their collections. Follow-up activities have focused on training genebank staff, implementing pcGRIN as the documentation tool for the project genebanks, standardizing descriptors and improving data exchange. IPGRI has also helped the project to produce descriptors for the Andean tuber oca.

Organic bananas help smallholders compete in world markets

IPGRI's INIBAP programme is helping smallholder banana farmers in the Caribbean develop strategies to better compete in the global marketplace.

Organic production may open up new markets for Caribbean banana farmers, whose traditional sales outlets are shrinking because of recent changes in world trading rules. INIBAP promotes the exchange of information between banana producers and organic produce retailers, and the development of new varieties that yield well and withstand disease without the use of chemical inputs. These activities could help Caribbean banana producers to enter organic markets and thus to maintain or improve their incomes.

In the Caribbean, bananas are grown almost exclusively by small-scale farmers for whom banana exports are an important source of income. Until recently, approximately 400 000 tonnes of Caribbean bananas were exported each year to the European Union. However in 1999, preferential market agreements between the European Union and Caribbean banana producers were declared to be inconsistent with World Trade Organization rules, and may soon have to be removed. This puts Caribbean banana farmers' livelihoods at risk, unless new marketing strategies can be developed.

Organic production — agriculture without chemically derived fertilizers and pesticides — could help Caribbean banana farmers to capture new markets in Europe, Japan and North America. The emphasis of organic production is on reducing pest and disease damage and on maintaining production through management practices, rather than chemical inputs. Organic products are sold at premium prices, perhaps 20% higher than non-organic products, meaning that farmers could receive more income from their exports, even if they produce and sell fewer bananas. Experience in the Dominican Republic has shown that organic production can result in increased revenues for small- and medium-scale farmers and lead to a reduction in rural poverty.

In November 1999, INIBAP, in partnership with CAB International and the Technical Centre for Agricultural and Rural Cooperation (CTA), organized a workshop to discuss the potential for organic banana production in the Caribbean. Participants from 25 countries represented the key players in the farm-to-table chain, including farmers, researchers, organizations that certify

Better bananas resist diseases *and* hurricanes

Banana production in Cuba in the early 1990s was devastated by the rapid spread of black Sigatoka disease and by hurricane damage. To respond to the destruction of the banana crop, Cuba began a massive replanting campaign to introduce hybrid bananas produced by FHIA with support from INIBAP. The hybrids produced a good yield, some bunches weighing over 90 kg, without the need for chemical pest control treatments.

As it turns out, the hybrid bananas were also better able to withstand the effects of hurricane winds than traditional varieties. They were put to the test in 1998 when Hurricane George hit Cuba. Hurricane winds destroyed up to 70% of the traditional Cavendish bananas, whereas 95% of the hybrids survived.

FHIA hybrids will continue to be introduced into areas affected by black Sigatoka and Cuba estimates that banana and plantain production will reach a level of 1.5 million tonnes in 2000, a threefold increase over production in 1996.

FHIA 23, an improved dessert banana variety, extensively cultivated in Cuba

FHIA, Honduras

bananas and plantains

organic produce, and importers. A number of representatives from the marketing and retailing sector participated in the meeting as well, providing them with a unique opportunity to interact with banana producers. As a result of the workshop, an action plan was developed to address the constraints identified by participants. Funds are being sought to implement the action plan. In the short term, a task force was established to explore the supply and demand situation for organic bananas.

Improved banana varieties developed by banana breeding programmes such as that of the Fundación Hondureña de Investigación Agrícola (FHIA) in Honduras may be suitable for organic production because yield can be maintained without the use of pesticides, inorganic fertilizers and other chemical inputs. Recent trial results have shown that hybrids from FHIA, produced and disseminated with support from INIBAP, consistently give higher yields than local varieties. FHIA-23, for example, produced average bunch weights of 31 kg, compared with 17 kg for local varieties. As a result of the organic banana workshop, further testing of hybrid bananas will take place in the Caribbean to assess their suitability for export-scale organic production.

A full report of the International Workshop on the Production and Marketing of Organic Bananas by Smallholders and other information about bananas is available on the World Wide Web at http://www.inibap.fr or http://www.cgiar.org/ipgri/inibap/

Banana and plantain production in Cuba is currently estimated at 1.5 million tonnes, three times more than in 1996

INIBAP

Information tools: bridging the gap between conservation and use

information tools to manage germplasm

Plant genetic diversity is often conserved in genebanks to keep it safe, genetically stable and easily accessible to users. But to be truly useful, it has to be accompanied by detailed and easily retrievable information. When looking for useful traits, a plant breeder will examine a wide range of materials by searching in a genebank's information or documentation system for data on the origin and characteristics of the conserved material as well as on its behaviour in different environments.

Germplasm data must be organized and analyzed in order to be accessible and meaningful to potential users. The tools to perform these tasks are available, but they are not yet in place in many genebanks, particularly in developing countries. IPGRI is making it easier for genetic resources workers to document and explore collections as well as to identify promising accessions, through the development of crop descriptors. The descriptors provide a universally understood "language" for plant genetic resources data, which allows them to serve as a reliable and efficient way to store, retrieve and communicate information.

By 1999, IPGRI had produced descriptor lists for over 80 crop and fruit tree species. Each has involved an enormously consultative process, calling on networks, CGIAR Centres, UPOV and crop experts from all over the world. According to an IPGRI study conducted this year, the lists are now being used in 137 countries.

IPGRI descriptors have also been used to facilitate access to specific germplasm accessions. The *Citrus* genetic resources network in France has based its documentation system, which contains data about nearly 6000 *Citrus* accessions, on IPGRI descriptors. IPGRI/FAO multicrop descriptors are also used by SINGER (see box) to standardize the information contained in the databases of 11 CGIAR Centres that hold in trust collections of crop genetic resources.

IPGRI has helped genebanks to move from manual to fully computerized documentation systems. This allows the search for relevant materials to be completed in a matter of minutes rather than days, weeks or even months, as was often the case with the old manual systems. IPGRI's work with USDA to further develop and disseminate the pcGRIN software is an example of this activity (see box).

INIBAP developed the *Musa* Germplasm Information System (MGIS) to help genebank curators manage their collections and provide access to users. Based on the *Musa* descriptors developed by IPGRI, MGIS contains information on over 3600 accessions of banana and plantain held in genebanks worldwide. Data about the characteristics of *Musa* collections are sent by genebanks to INIBAP to be compiled on CD-ROM and distributed to genebank managers and other users. MGIS will soon be accessible on-line from the SINGER web site.

IPGRI has assisted genebanks to provide easier access by users to the germplasm they

PcGRIN documentation software

PcGrin, a personal computer software package for genebank documentation, stores and manages information on germplasm collections, including passport, taxonomic, evaluation and inventory data. PcGRIN allows users to search for a variety of traits and genebank managers to deliver and monitor germplasm orders. IPGRI and the United States Department of Agriculture (USDA) jointly conducted the conceptual analysis and design of the software, which was then implemented by USDA database specialists. IPGRI translated the software and user's manual into Spanish and has supported its adoption by national genebanks through a series of training workshops. IPGRI's involvement in the development and implementation of pcGRIN in Latin America has made it possible to manage the regional green pepper and squash collections (4000 accessions) held at the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) in Costa Rica. Currently, about 25 000 accessions of crops native to the region are being managed with pcGRIN software in various countries. This number is expected to grow rapidly in the future.

SINGER

The System-wide Information Network for Genetic Resources (SINGER) is an activity of the CGIAR System-wide Genetic Resources Programme (SGRP), hosted by IPGRI. SINGER links the genetic resources information systems of the CGIAR Centres, allowing them to be accessed and searched collectively. SINGER contains data on the identity, source, characteristics and transfer to users of more than half a million samples of crop, forage and agroforestry species of major importance for food and agriculture. SINGER's new user-interface (http://singer.cgiar.org) integrates multiple query functions with mapping, graphical, statistical and other features, making the system flexible and easy to use. In the future, SINGER will foster greater information exchange on genetic resources worldwide by promoting the use of common data standards and through its links with national, regional and international systems such as FAO's WIEWS and the CBD Clearinghouse Mechanism.

hold, as well as to exchange information with other genebanks. DIPVIEW, a protocol developed by IPGRI, provides users with remote access to genebanks, allowing them to simultaneously search for germplasm in a number of places. Genebank managers can also use DIPVIEW to exchange data, even if the systems they operate from have different characteristics. The protocol is being successfully used in India and other South Asian countries to provide and exchange data as well as to prepare germplasm catalogues.

IPGRI germplasm databases contain summary information on more than 5 million accessions held worldwide, including contact details for genebanks. The databases are linked with the FAO World Information and Early Warning System (WIEWS). They are available for consultation at http://www.cgair.org/ipgri/doc/dbintro.htm.

The value of plant genetic resources rests in their characteristics, the worth of the product obtained from their use and the contribution they make to land management and production. By providing information tools that can be used alone or in combination, IPGRI is helping genebanks to record germplasm data consistently and accurately, and to make the data accessible to users.

National programme staff participating in a documentation course held in Cali, Colombia

IPGRI

Selected IPGRI publications of 1999

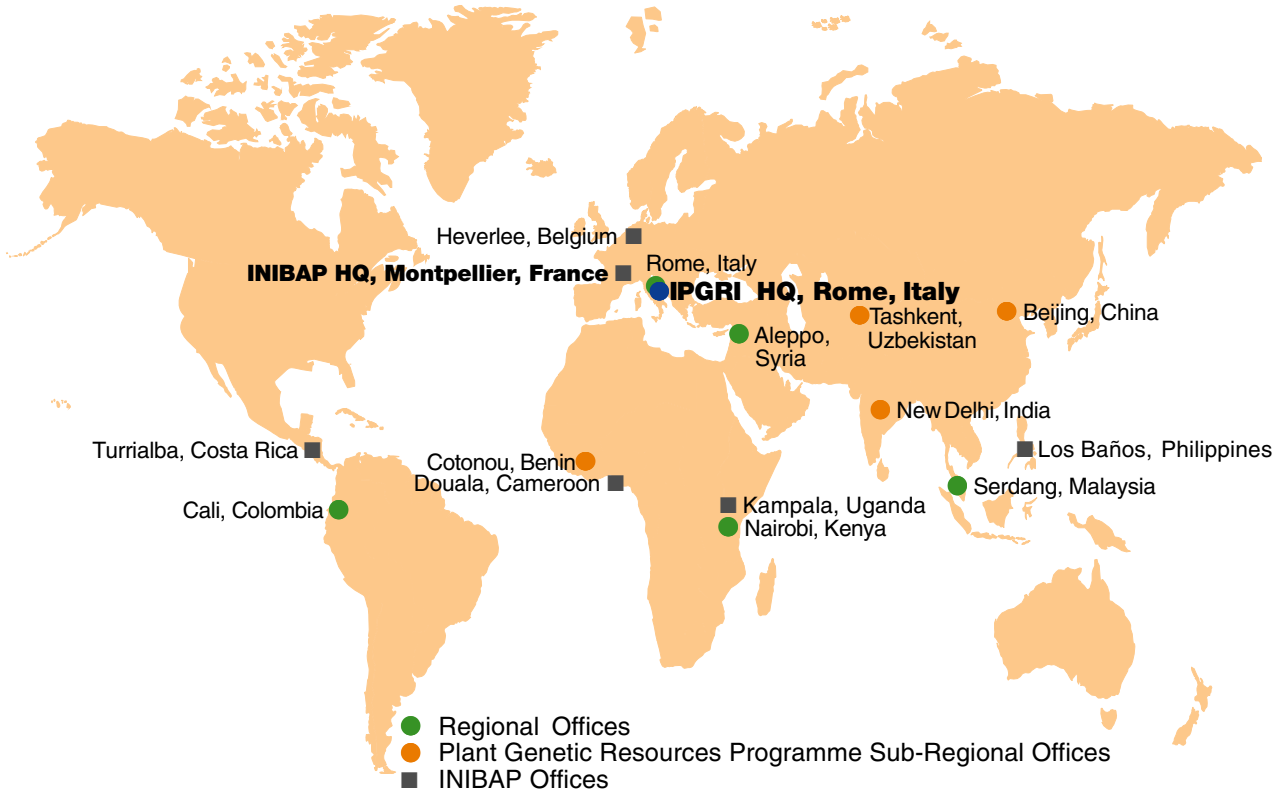
- IPGRI 1998 Annual Report
- INIBAP 1998 Annual Report
- SGRP Annual Report 1998
- Diversity for Development: The Strategy of the International Plant Genetic Resources Institute
- Diversity for Development - Highlights of IPGRI's Strategy
- SGRP Strategy
- Issues Paper No. 8 - Strengthening National Programmes for Plant Genetic Resources for Food and Agriculture: Planning and Coordination (with FAO)*
- Regeneration of seed crops and their wild relatives (with FAO, SGRP)
- Characterization and Documentation of Genetic Resources Utilizing Multimedia Databases (with the University of Naples Federico II)
- FAO/IPGRI Plant Genetic Resources Newsletter Nos. 117-120 (with FAO)
- Promoting Multi-purpose Uses and Competitiveness of the Coconut (with COGENT)
- Coconut Breeding (with COGENT)
- Coconut Embryo *In Vitro* Culture (with COGENT)
- Wild and Cultivated Carrot Descriptors [English, French, Spanish]
- Taro Descriptors [English, French, Spanish]
- Implementation of the Global Plan of Action in Europe (with FAO, BAZ-Germany)
- The Biodiversity of Traditional Leafy vegetables (with the Netherlands Ministry of Foreign Affairs Development Cooperation)
- The Origin of Agriculture and Crop Domestication (with ICARDA, FAO, Genetic Resource Conservation Programme)
- Priority Species of Bamboo and Rattan (with INBAR)
- Vavilov and his Insitute (VIR)
- El Rol del Genero en la Conservacion, Localizacion y Manejo de la Diversidad Genetica de Papa, Tarwi (with BIOSOMA-FAO)
- Strengthening National Programmes for Plant Genetic Resources for Food and Agriculture: (with FAO)
- Geneflow 1999
- *In situ* Conservation of Plant Genetic Resources in Home Gardens of Southern Vietnam (with the Swiss Agency for Development and Cooperation)
- Key Questions for Decision-Makers (with GTZ-Germany)
- Sustainable Forest Genetic Resources Programmes in the Newly Independent States of the Former USSR (with Arbora Publishers, Zvolen, Slovakia)
- Core Collections for Today and Tomorrow (with the Crop Science Society of America)

IPGRI publications

* Collaborators are indicated in parentheses

Institutional structure

Geographical



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Financial report

for the year ended 31 December 1998, in US dollars ('000)

Grant Revenue*

Unrestricted and Attributed	
Australia	319
Austria	50
Belgium	242
Canada	472
China	110
Denmark	669
France	217
Germany	327
India	75
Italy	1 335
Japan	2 104
Mexico	15
Netherlands	1 037
Norway	394
Republic of Korea	50
South Africa	60
Spain	50
Sweden	423
Switzerland	610
Thailand	15
United Kingdom	1 018
USA	600
World Bank	2 900
Subtotal	**13 092**

1 Australia's 2000 unrestricted contribution received in December 1999.
2 Belgium's 1998 and 1999 unrestricted contributions of BF10 141 500 at year-end rate of exchange of BF40.2454=US$1.00.
3 European Union 1998 unrestricted contribution of EURO1 280 000 at year-end rate of exchange of EURO 0.9977=US$1.00.
4 France's 1999 unrestricted contribution of FF1 362 500 at year-end rate of exchange of FF6.5442=US$1.00.
5 Includes US$700 000 for the new HQ construction in Maccarese.
6 Includes US$210 000 for the new HQ construction in Maccarese.
7 The Netherlands 2000 unrestricted contribution received in December 1999.
8 Sweden's 1999 unrestricted contribution of SK1 775 000 at year-end rate of exchange of SK8.543=US$1.00.
9 Switzerland's 2000 unrestricted contribution received in December 1999.
10 The World Bank's 2000 unrestricted contribution received in December 1999.

Restricted	
Australia	45
ADB	255
AfDB	96
Belgium	1 132
Brazil	1
Canada	28
CATIE	10
CFC	646
CIRAD	54
COLCIENCIAS	9
CTA	80
Denmark	230
European Countries	459
FAO	28
Finland	2
France	190
Germany	605
IDRC	210
IFAD	663
IRRI	1
Italy	37
Japan	248
Luxembourg	115
Netherlands	288
Norway	3
Peru	57
Philippines	17
Portugal	124
PRGA	39
Republic of Korea	17
Spain	139
Sweden	107
Switzerland	856
TBRI	23
Technova	6
United Kingdom	49
UNDP	1
UNEP	114
USA	2
USDA	20
World Bank	50
Subtotal	**7056**

Total Grants	**20 148**

* Plus in-kind contributions of Associate Experts/Staff seconded by Belgium/VVOB (3), France/CIRAD (2), Italy (1), the Netherlands (5), Sweden (1).

Restricted projects

Australia	
Associate Expert - Vietnam	30
IMTP Trial Sites	9
Taro Genetic Resources Conservation and Utilization Project	6
Subtotal	45
African Development Bank	
Musa Genetic Resources	35
Plant Genetic Resources in Sub-Saharan Africa	61
Subtotal	96
Asian Development Bank	
Coconut Genetic Resources Network and Human Resources Strengthening in Asia and the Pacific Region (Phase II)	255
Belgium	
Collaborative *Musa* Research - KUL	356
Gembloux - *Musa* Virus Diseases	163
INIBAP Transit Center - KUL	263
Musa Coordination in Africa	202
Studies on Breeding Systems (*Phaseolus Lunatus*) Phase II	146
Study of Diversity (*Colletotrichum* and *Stylosanthes*) Phase II	2
Subtotal	1 132
Brazil	
The Lusophone Meeting	1
Canada	
Developing Decision-Making Strategies on Priorities for Conservation and Use of Forest Genetic Resources	28
CATIE	
Hurricane Mitch Damage Assessment	10
CFC	
Banana Improvement Programme Assessment	9
Cocoa Germplasm Utilization and Conservation	506
Coconut Germplasm Utilization and Conservation	110
Musa Project Development	21
Subtotal	646
CIRAD	
Musa Publications	23
Musa Nematode Research	31
Subtotal	54
COLCIENCIAS	
Conservation and Use of Genetic Resources of *Passiflora*	9
CTA	
CRBP Symposium Proceedings	27
Information Services/Publications	25
Organic Banana Production Workshop	28
Subtotal	80
Denmark	
Junior Professional Officer - Benin	88
Junior Professional Officer - Colombia	60
Effective Conservation and Use of Intermediate and Recalcitrant Tropical Forest Tree Seed Phase II	82
Subtotal	230
European Countries	
ECP / GR - Phase VI	255
EUFORGEN - Phase I	191
Plant Genetic Resources Symposium	13
Subtotal	459
FAO	
Field Genebank Course	3
National Programme Strategies and In Vitro Conservation Manual	4
Plant Genetic Resources Newsletter	19
Decision guides	2
Subtotal	28
Finland	
Associate Expert - Malaysia	2
France	
Associate Expert - LACNET Coordination – Costa Rica	42
International Coconut Database	33
Musa Germplasm Information System	27
Peri-urban Banana Production in West Africa	56
VIC MPL Virus Indexing Center	32
Subtotal	190
Germany	
BMZ/GTZ - Forest Genetic Resources in Brazil and Argentina	140
BMZ/GTZ – Underutilized and Neglected Crops Project	3
BMZ/GTZ – Contribution of Home Gardens to *In Situ* Conservation	163
BMZ/GTZ - *In Situ* Conservation (Morocco component)	222
GTZ - Managing Agrobiodiveristy in Rural Areas	15
GTZ - Southern African Workshop on TRIPS	56
GTZ - Towards a *Sui Generis* System	6
Subtotal	605
IDRC	
Associate Scientist - Italy	56
Community Level Management of Plant Genetic Resources	0
Conserving Medicinal and Aromatic Plant Species	10
Crucible Meetings	75
Hurricane Mitch Damage Assessment	10
In Situ Conservation of Agricultural Biodiversity	7
LAC - *Musa* Small Grants - Phase II	4
Musa Germplasm Information System	12
Musa In Situ Conservation	21
Organic Banana Workshop Proceedings	15
Subtotal	210
IFAD	
Sustainable Use of Coconut Genetic Resources in the Asia-Pacific Region	312
In Situ Conservation and Utilization of PGR in Desert Prone Areas of Africa	227
Conservation of Indigenous Plant Genetic Resources in the Libyan Arab Jamahiriya	109
Workshop on Enlarging the Basis of Food Security	15
Subtotal	663
IRRI	
Germplasm Collecting in Uganda and Kenya	1

Financial support

Italy	
Image Processing	3
Plant Genetic Resources Support in Sub-Saharan Africa	21
Conservation and Use of Genetic Resources of Underutilized Mediterranean Species	8
Individual Training in Plant Genetic Resources	5
Subtotal	37
Japan	
Collaborative Activities	74
Bamboo and Rattan Project	124
Genetic Resources Policy	50
Subtotal	248
Luxembourg	
Genetic Resources of Broadleaved Forest Tree Species in Southeastern Europe	115
Netherlands	
Biodiversity of Neglected Leafy Green Vegetable Crops	8
In Situ Conservation in Burkina Faso and Nepal	280
Subtotal	288
Norway	
Genetic Resources Policy	3
Peru	
Banana Research	57
Philippines	
Philippine *Musa* Characterization and Collection	17
Portugal	
The Lusophone Countries of Africa Initiative on Plant Genetic Resources	124
Republic of Korea	
Associate Scientist - Malaysia	17
Spain	
Canary Island Project (*Musa*)	30
Cherimoya Germplasm Bank in Peru	30
Training Programme	79
Subtotal	139
Sweden	
Genetic Resources Policy	90
Eastern Africa Regional Meeting	17
Subtotal	107
Switzerland	
Genetic Resources Policy	87
In Situ Conservation of Agricultural Biodiversity	630
Banana Integrated Pest Management Conference	14
SINGER Phase II	119
Workshop on Ethics and Equity in Conservation and Use of Genetic Resources for Sustainable Food Security	6
Subtotal	856
TBRI	
RISBAP	23
Technova	
Research on Sweet Potato	6
PRGA	
Farmers Domestication and Improvement of Yam in West Africa	39
UNDP	
IMTP - Phase II	1
UNEP	
Capacity Building for Sustainable National Plant Genetic Resources Programmes	69
Forestry Genetic Resources Workshop	18
SAFORGEN - Medicinal Tree Species Network Workshop	27
Subtotal	114
UK/DFID	
Coconut Publications	4
Holdback Project R6110H (Cryopreservation Techniques for Plant Species in India)	7
Subtotal	11
UK/Darwin	
Darwin Initiative - Cameroon	38
USA	
Network Funding and Strategic Planning	2
USDA	
Development/Testing of Geographical Information System for Locating Cultivated Plant Diversity	11
In Situ Conservation of Wild Crop Relatives in Paraguay	9
Subtotal	20
World Bank	
CGIAR Genetic Resources Policy	15
Germplasm conservation in Central Asia and the Caucasus	14
Intellectual Property Rights Audit	21
Subtotal	50
Total Restricted Research Agenda Grants	**7056**

Financial support for the Research Agenda of IPGRI was provided in 1999 by the Governments of:

Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, F.R. Yugoslavia (Serbia and Montenegro), Finland, France, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Republic of Korea, Lithuania, Luxembourg, Macedonia, Malta, Mexico, Monaco, the Netherlands, Norway, Peru, the Philippines, Poland, Portugal, Romania, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, the UK and the USA

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African Development Bank, the Asian Development Bank, Common Fund for Commodities, Technical Centre for Agricultural and Rural Cooperation (CTA), European Union, Food and Agriculture Organization of the United Nations (FAO), International Development Research Centre (IDRC), International Fund for Agricultural Development (IFAD), International Association for the promotion of cooperation with scientists from the New Independent States of the former Soviet Union (INTAS), Interamerican Development Bank/Fontagro, Natural Resources Institute (NRI), Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), Nordic Genebank, Rockefeller Foundation, TBRI, Technova, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP) and the World Bank.

Establishment agreement

The international status of IPGRI is conferred under an Establishment Agreement which, by June 1999, had been signed and ratified by the Governments of:

Algeria, Australia, Belgium, Benin, Bolivia, Brazil, Burkina Faso, Cameroon, Chile, China, Congo, Costa Rica, Côte d'Ivoire, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Greece, Guinea, Hungary, India, Indonesia, Iran, Israel, Italy, Jordan, Kenya, Malaysia, Mauritania, Morocco, Norway, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

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* Joined during 1999
** Left during 1999
*** Moved Groups during 1999

IPGRI's projects

Support to plant genetic resources programmes and regional networks in the Americas
assists countries in Latin America and the Caribbean to build up their capacities to conserve and use plant genetic resources

Support to plant genetic resources programmes and regional networks in Asia, the Pacific and Oceania
assists countries in Asia, the Pacific and Oceania to build up their capacities to conserve and use plant genetic resources

Support to plant genetic resources programmes and regional networks in Europe
assists countries in Western and Eastern Europe to build up their capacities to conserve and use plant genetic resources

Support to plant genetic resources programmes and regional networks in sub-Saharan Africa
assists countries in sub-Saharan Africa to build up their capacities to conserve and use plant genetic resources

Support to plant genetic resources programmes and regional networks in Central & West Asia and North Africa
assists countries in Central & West Asia and North Africa to build up their capacities to conserve and use plant genetic resources

Global capacity building and institutional support
trains scientists and trainers and develops training tools

Global forest genetic resources strategies
supports strategic research on the conservation and use of intraspecific diversity of useful forest tree species. It also aims to develop an information system on forest genetic resources

Promoting sustainable conservation and use of coconut genetic resources
promotes national, regional and global collaboration through COGENT among coconut-producing countries and partner institutions in the conservation and use of coconut genetic resources

Locating and monitoring genetic diversity
develops methods for locating and measuring genetic diversity in cultivated and wild species, combining ethnobotanical with agro-ecological approaches. It also develops methods for monitoring genetic erosion

***Ex situ* conservation technologies and strategies**
develops improved low-input technologies for the *ex situ* conservation of plant genetic resources, and investigates *ex situ* conservation strategies

***In situ* conservation of crop plants & wild relatives**
develops a scientific basis for effective on-farm conservation that meets farmer and community needs and maintains diversity; assists national systems in locating, monitoring and maintaining viable *in situ* populations of wild relatives of crops

Linking conservation and use
taking *ex situ, in situ* and complementary approaches; emphasizes neglected and underused crops and supports the use of cocoa genetic resources

Human and policy aspects of plant genetic resources conservation and use
strengthens links between conservation and the well-being of people, particularly poor rural people, emphasizing gender, nutrition, income, indigenous knowledge, traditional resource rights and participatory approaches

Information management and services
builds capacity in information management and service provision to meet national, regional and international responsibilities; provides publications and information to support the research activities of IPGRI staff and their partners

Public awareness and impact assessment
builds financial and institutional support for plant genetic resources activities worldwide by raising awareness among key target audiences of the role of these resources in sustainable development and food security; assesses IPGRI's impact on the conservation and use of plant genetic resources

***Musa* genetic resources management**
collects the germplasm of *Musa* and its wild relatives; promotes its safe storage, movement and use; develops standardized tools for retrieving and exchanging information on *Musa* germplasm

***Musa* germplasm improvement**
identifies disease- and pest-resistant *Musa* genotypes, researches *Musa* pathogen diversity, screening methods and molecular genetics and develops improved *Musa* genotypes; provides *Musa* germplasm

***Musa* information and communication**
supports the production, collection and exchange of information on banana and plantain; publicizes *Musa* issues and the work of INIBAP to scientific and non-technical audiences

Support to regional *Musa* programmes
supports INIBAP's global regional and national networks and other partnerships in Latin America and the Caribbean, in Asia, the Pacific and Oceania, and in sub-Saharan Africa

CGIAR genetic resources support programme
provides support to the CGIAR system in two areas: (1) genetic resources policy, (2) in IPGRI's capacity as convening centre of CGIAR's System-wide Genetic Resources Programme (SGRP).

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Acronyms

ADB	Asian Development Bank
AfDB	African Development Bank
APO	Asia, the Pacific and Oceania
BIOSOMA	Biodiversidad, Sostenibilidad y Medio Ambiente
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CBD	Convention on Biological Diversity
CFC	Common Fund for Commodities
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical, CGIAR
CIP	International Potato Center, CGIAR
CIRAD-FHLOR	Centre de Coopération Internationale en Recherche Agronomique pour le Développement, Département des Productions Fruitières et Horticoles, France
COGENT	Coconut Genetic Resources Network
CORAF	Conférence des Responsables de Recherche Agronomique Africains
CTA	Technical Centre for Agricultural and Rural Cooperation, the Netherlands
CWANA	Central and West Asia and North Africa
DSE	German Foundation for International Development
EAPGREN	East African Plant Genetic Resources Network
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
EUFORGEN	European Forest Genetic Resources Programme
FAO	Food and Agriculture Organization of the United nations
FHIA	Fundación Hondureña de Investigación Agrícola
GIS	Geographical Information Systems
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, Germany
IDRC	International Development Research Center, Canada
IFAD	International Fund for Agricultural Development
IRRI	International Rice Research Institute, CGIAR
INBAR	International Network for Bamboo and Rattan
INIBAP	International Network for the Improvement of Banana and Plantain, IPGRI-CGIAR
IPGRI	International Plant Genetic Resources Institute, CGIAR
MGIS	*Musa* Germplasm Information System
PROFRUTA	Proyecto de Desarrollo de Fruticultura y Agroindustria, Guatemala
SGRP	CGIAR System-wide Genetic Resources Programme
SINGER	System-wide Information Network on Genetic Resources
SSA	Sub-Saharan Africa
TANSAO	Taro Network for Southeast Asia and Oceania
TaroGen	Taro Genetic Resources Network
TBRI	Taiwan Banana Research Institute
UNEP	United Nations Environment Programme
UPOV	Union for the Protection of New Varieties of Plants
USDA	United States Department of Agriculture
WIEWS	FAO's World Information and Early Warning System

Annual Report 1999

The International Plant Genetic Resources Institute (IPGRI) is an international scientific organization, supported by the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of plant genetic resources for the benefit of present and future generations. IPGRI's headquarters are in Rome, Italy, with offices in another 14 countries worldwide. It operates through three programmes:

- **the Plant Genetic Resources Programme**
- **the CGIAR Genetic Resources Support Programme**
- **the International Network for the Improvement of Banana and Plantain (INIBAP)**

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